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(54) **PARTICULATE INSULATION MATERIALS**

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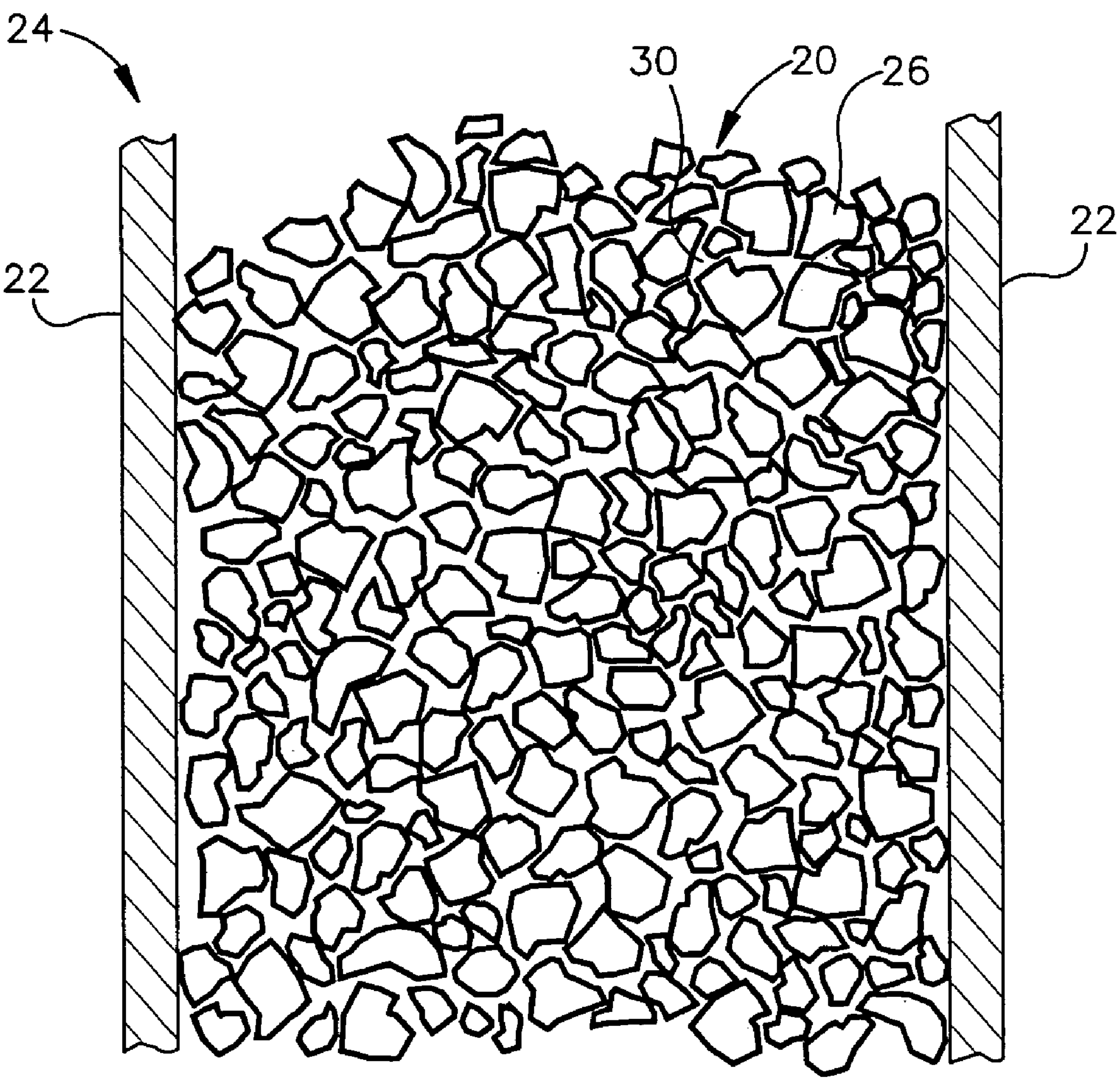
(57) **ABSTRACT**

A particulate insulation comprises a plurality of particles. Each of the particles has a density of at least about 1 g/cm^3 and includes a material that is viscoelastic, elastomeric, and/or polymeric. The particles are substantially non-toxic, non-hygroscopic, odorless, and resistant to volatile organic compound (VOC) emissions.



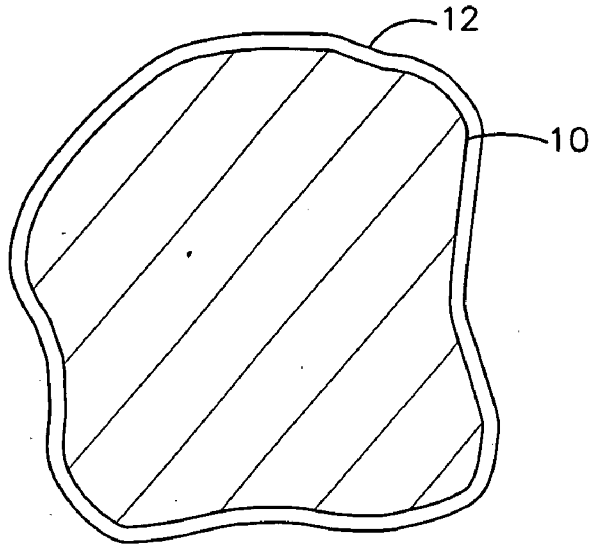


Fig. 1

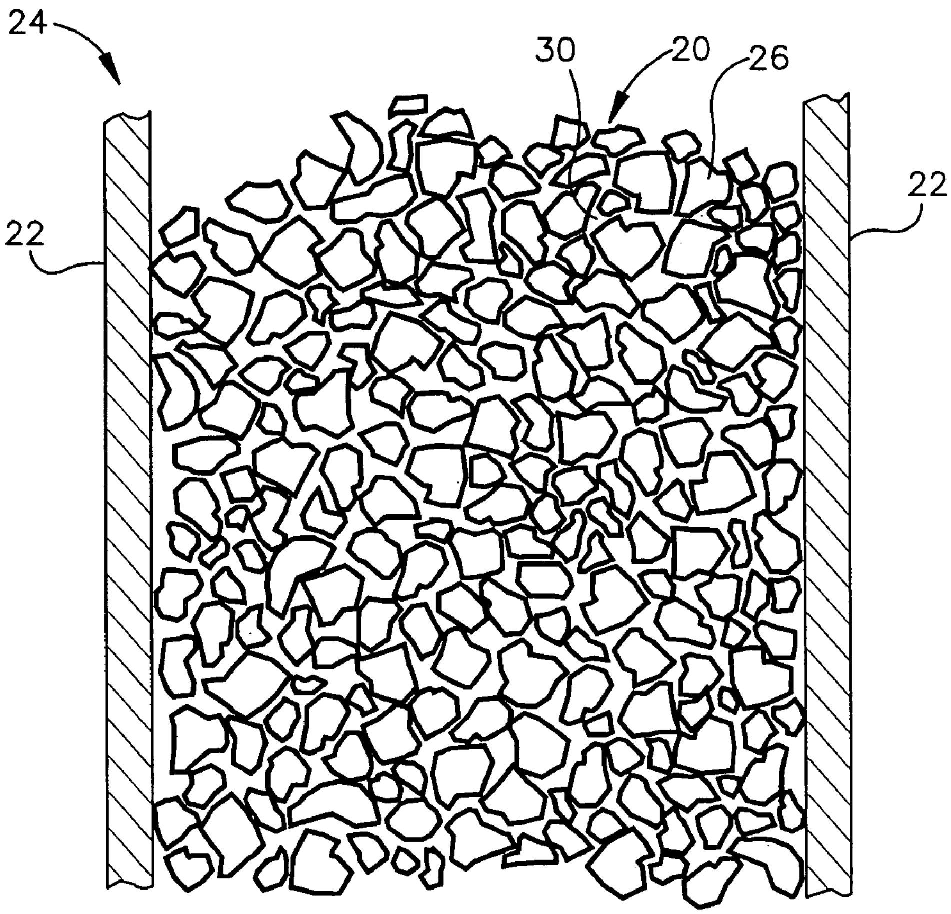


Fig. 2

PARTICULATE INSULATION MATERIALS

FIELD OF THE INVENTION

[0001] The present invention relates to an engineered insulation material, and more particularly to a particulate, granular or chip-type insulation material having acoustic damping and/or isolation properties.

BACKGROUND OF THE INVENTION

[0002] A variety of insulation materials have been proposed for abating sound transmission from a source thereof to some protected area or enclosure. For example, insulation materials can be used to abate sound through the walls and ceilings of houses, buildings and the like, from appliances, such as washing machines and dishwashers, from the exterior of vehicles, such as automobiles, airplanes, trains, and ships, from machinery, such as presses, compressors, blowers, and HVAC systems, and from pipes and duct work.

[0003] Typically, acoustical insulation material is in the form of a layer of synthetic material, such as a rubber mat or rubber member. The rubber mat or rubber member can be formed, for example, from bituminous material, a bituminous/rubber material, or a polymeric material that is either dense in and of itself and/or has added thereto densifying materials in order to be more effective. The rubber mat or rubber member can be adhered to a surface of, for example, a wall or ceiling and be used to absorb sound waves or dampen vibrations.

[0004] U.S. Pat. No. 5,916,681 teaches an insulating particulate material, which may be used in construction. The particulate material has a sound absorbing and/or sound isolating high density core which is surrounded by a relatively less dense thermally insulating outer coating. The insulating outer coating advantageously prevents thermal conduction, while the higher density core absorbs, reflects and/or refracts sound waves to reduce the propagation of sound waves through the granules. The high density core may be chosen from any number of materials which absorb, reflect, and/or diffract sound waves, including metals, recycled waste materials, and metal scrap.

SUMMARY OF THE INVENTION

[0005] The present invention relates to an engineered insulation material that can be readily modified to achieve various performance and application characteristics, while optimizing supply, cost, color and other related variables. The engineered insulation material includes a plurality of particles. Each of the particles has a density of at least about **1** g/cm^3 and includes at least one of a viscoelastic, elastomeric, and/or polymeric material. The particles are substantially non-toxic, odorless, and resistant to volatile organic compound (VOC) emissions. The material used to form the particles can be selected from the group consisting of a crumb rubber, a reground polymer, a recycled polymer, a virgin polymer, and/or blends thereof. The particles can have a polydiverse particle size distribution and comprise different irregular shapes to tailor the packing density and void density of the insulation material. The average particle diameter of the material can be about 0.04 mm to about 25 mm.

[0006] Each particle can include a surface coating. The coating can be substantially impermeable and mitigate release of odor and VOCs from the material. The coating can be substantially free of voids and comprise less than about 20% by volume of the particles. The surface coating can include a coupling agent or a polymer, such as a urethane, an epoxy, an acrylic, a silicone, a latex, water reducible resins and blends thereof.

[0007] Optionally, the particulate insulation can further include an agent, such as a fungicide, insecticide, mildewcide, bactericide, colorant, flame retardant, radiation absorber (e.g., actinic or UV), anti-blocking agent, and/or a filler. The filler can be included in an amount effective to provide each particle with a density greater than about 1 gram/cm^3. Examples of fillers that can be used include talc, glass beads, dolomite, calcium carbonate, glass microspheres, fly ash, clay, silica, silicate, perlite, vermiculite, aluminum hydrate, and barium sulfate.

[0008] The size, shape, and density of the particulate insulation material can be readily modified to achieve various performance applications. For example, the particulate insulation can have an R-value of at least about 2.0 per inch, an STC factor of at least about 20, and be capable of damping, attenuating, or isolating at least one of vibrational energy, acoustic energy, thermal energy, electromagnetic energy, or radio waves.

[0009] In one aspect of the invention, the particulate insulation can be provided in or on a construction (e.g., wall, ceiling, or roof) or assembly in the form of free-flowing dry particles. The free-flowing dry particles can be provided in or on the assembly using blowing, pumping or pouring methods.

[0010] In another aspect of the invention, the particulate insulation can be provided in a coating composition that can adhered to the surface of an assembly. The coating composition can also include a resin system as well as diluents, viscosity modifiers, additives, colorants, and/or other fillers. The viscosity of the coating composition should be such that it can be readily sprayed, brushed, or poured on the surface.

[0011] In yet another aspect of the invention, the particulate insulation can be provided in a mastic or paste that can be provided in or on the surface of an assembly. The mastic or paste can also include a viscous resin or polymer, which acts as a bonding agent for the particulate insulation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Further features of the present invention will become apparent to those skilled in the art to which the present invention relates from reading the following description of the invention with reference to the accompanying drawings in which:

[0013] **FIG. 1** illustrates a schematic cross-sectional view of a particulate insulation material in accordance with an aspect of the invention.

[0014] **FIG. 2** illustrates the particulate insulation material provided between the walls of a construction assembly.

DETAILED DESCRIPTION

[0015] The present invention relates to an engineered particulate insulation material. By particulate, it is meant that the insulation material is in the form of distinct particles, such as powders, granules, chips, pellets, nodules, or prills and is not in the form of fibers, filaments, whiskers or other high aspect ratio forms where, for example, the length to diameter is greater than about 100. The particulate insulation material can be used in any assembly including vehicles, such as railway cars, buses, trailers, automobiles, planes, helicopters, and mobile homes, temporary partitions, such as office dividers, appliances, such as dishwashers and refrigerators, in construction assemblies, such as a closed wall or ceiling cavities and fabrications, as well as open walls, ceilings, roofs, structural panels, and machinery, such as presses, compressors, blowers, and HVAC systems, as well as around pipes and duct work. Advantageously, the particulate insulation material in accordance with the present invention can be used in both new and retrofit applications.

[0016] The particulate insulation material in accordance with the present invention comprises a particulate viscoelastic, elastomeric, and/or polymeric material that, in contrast to conventional insulation materials, such as fiberglass, mineral wool, cellulose, and reacted polymers foams, has a density, which is greater than about 1 g/cm^3 and, preferably, greater than about 1.2 g/cm^3. More particularly, the density of the particulate viscoelastic, elastomeric, and/or polymeric material used to form the particles of insulation material is such that the density of the insulation material can be varied from about 1.0 g/cm^3 to about 3.0 g/cm^3. The density as well as the composition of the insulating material can be tailored to provide an insulation material that is capable of damping, attenuating, and/or isolating various energies, such as, vibrational energy, acoustic energy, thermal energy, electromagnetic energy, or radio waves. For example, the insulating material in accordance with the present invention can have a thermal resistance value (i.e., R-value) of at least about 2.0 per inch and a sound attenuation factor (i.e., STC factor) of at least about 20. The insulating material in accordance with the present invention can also be clean handling and have a minimal toxicity, high heat resistance, low rate of moisture absorption, and high dimensional stability.

[0017] In one aspect of the invention, the particulate viscoelastic, elastomeric, and/or polymeric material used to form the particulate insulation material can comprise crumb rubber. The crumb rubber used in the insulation material of the invention can include rubber particles that have an average particle size of about 0.04 mm to about 25 mm. The crumb rubber particles can include a natural, thermoplastic or synthetic rubber or mixtures of the rubbers. In most cases, the rubber can be comprised of repeat units, which are derived from one or more conjugated diolefin monomers, such as 1,3-butadiene or isoprene. Examples of synthetic rubbers are polysulfides, polychloroprene, butadiene-styrene copolymers (SBR), polyisoprene, butyl rubber (isobutylene-isoprene copolymers), polyacrylonitrile, polyurethane, silicone and nitrile (acrylonitrile-butadiene copolymers) polybutadiene polymers, styrene-isoprene, isoprene-butadiene rubber, styrene-isoprene-butadiene (SIBR), nitrile rubber (NBR) or carboxylated nitrile polymers (XNBR). Thermoplastic rubbers include block copolymers of styrene-butadiene or styrene isoprene.

[0018] The rubber may be obtained from recycled or reclaimed scrap rubber material. Included among the types of scrap rubber materials contemplated for use in the present invention are those derived from natural rubber, ethylene propylene terpolymer (EPDM), EPM copolymer, styrene butadiene rubber, polybutadiene rubber and nitrile rubber. Examples of types of post industrial scrap rubber sources include, (1) rubber scraps and rejected rubber parts generated from tire manufacturing processes, such scraps constituting mostly styrene butadiene rubber, polybutadiene rubber and natural rubber, (2) rubber scraps generated from automobile parts molding processes, such as molding flashes and rejected rubber parts, such scraps constituting EPDM rubber, (3) rubber scraps generated from extrusion processes in the manufacture of automobile windshields and window seals, such as start up rejects, blemished portions and rejected lengths, such scraps constituting EPDM rubber, (4) rubber scraps generated from calendaring processes in the manufacture of EPDM roofing membranes, such as torn sections, blemished and short run rejects, and (5) rubber scraps generated in the manufacturing processes of natural rubber latex gloves. Rubber scrap materials that are recovered from used articles discarded after use, conventionally termed “post consumer rejects”, can also be used. These rubber scraps can include, for example, (1) used passenger tires which are ground into fine powders and composed mostly of styrene butadiene rubber, (2) used truck tires ground into powders, most of which is composed of natural rubber and to a lesser smaller degree, polybutadiene rubber, (3) rubber automobile parts obtained from vehicle recovery programs (such as Ford Motor Company’s Vehicle Recycling Program) which are segregated into EPDM based parts of windscreens and window seals, and (4) natural rubber latex gloves used in electronic assembly lines and gathered after use for disposal.

[0019] The crumb rubber can be produced form the scrap rubber by grinding or shredding the scrap rubber and removing fibrous and steel material from the ground rubber. The recovery and use of such crumb rubber particles are more fully described in U.S. Pat. No. 5,811,477, the description of which is incorporated herein by reference. It will be appreciated that the crumb rubber need not be from scrap rubber sources and any portion or all of the rubber may be virgin.

[0020] It will also be appreciated by one skilled in the art that other particulate viscoelastic, elastomeric and/or polymeric materials can be used to form the particulate insulation material. These other particulate viscoelastic, elastomeric, and/or polymeric materials can include particles of polymers, such as thermoplastic and thermosetting synthetic polymers that have a density of greater than about 1 g/cm^3. Examples of thermoplastic polymers can include nylon, PVC, polyethylene, polystyrene, polypropylene, fluorocarbons, polyurethane acrylic resins, acrylates, and blends thereof. Preferred thermoplastic polymers include polyethylene, polypropylene, and blends thereof. Examples of thermosetting polymers can include cross-linked polyethylene, phenolics, alkyds, polyurethanes, and polyester resins.

[0021] Particles of these thermoplastic and thermosetting polymers can be obtained from scrap polymers, plastics, and/or elastomers as well as virgin or prime resin. The scrap thermoplastic and/or thermosetting synthetic polymer can be reground or recycled to provide the particles. Examples of particular scrap plastic resin components contemplated for use in the present invention are polypropylene copolymers (PP), polyethylene (e.g., low density polyethylene (LDPE) and high density polyethylene (HDPE)), as well as recycled plastic resins of these materials, such as polypropylene derived from recycling processes in the recovery of used battery cases. It is to be understood that the types of scrap polymers, plastics, elastomers, and/or resins disclosed herein are meant to be illustrative only and that scrap polymers, plastics, elastomers, and/or resins derived from other sources may be used in the instant invention.

[0022] It will be appreciated that the particulate insulation material can include combinations, blends, or mixtures of the crumb rubber and the particulate polymeric material. The particular combination, blend, or mixture will depend on such factors as the specific application or use of the insulation material, as well as the commercial availability.

[0023] It will also be appreciated that the particulate insulation material can be provided in a polydiverse particle size distribution. By this it is meant that the particulate insulation can comprise a blend of particles with different sizes and that these particle sizes (or diameters) can range from about 0.04 mm to about 25.0 mm. Additionally, the particles can comprise different shapes, including irregular (e.g., multi-faceted shapes) and regular shapes.

[0024] Each of the particles of viscoelastic, elastomeric, and or polymeric material (e.g., crumb rubber) used to form the particulate insulation material can be provided with a void-free surface coating that encapsulates individual particles. By void-free, it is meant the coating encapsulating each particle does not include any voids, cavities, nor has an expanded or cellular structure. **FIG. 1** is a schematic cross-sectional view of an example of a particle **10** provided with a surface coating **12**. The surface coating **12** can have a thickness less than about 0.10 mm. Preferably, the surface coating **12** has a thickness less than about 50 microns.

[0025] The surface coating **12** in accordance with the present invention can comprise any coupling agent and/or polymeric material that is substantially impermeable and mitigates emission of odor and volatile organic compounds from the particles of viscoelastic, elastomeric, and/or polymeric materials. The surface coating can also enhance humidity resistance and/or minimize hygroscopic characteristics. Viscoelastic, elastomeric, and/or polymeric materials can potentially include compounds, such as volatile organic compounds (e.g., organic plasticizers and organic solvents) or residual chemicals that can be released (e.g., emitted and/or evaporated) from the material. For example, crumb rubber typically includes about 1% to about 2% volatile organic compounds, which can evaporate from the rubber over time. The released compound can be in the form of liquid or gas, which can be malodorous as well as potentially toxic when accumulated (e.g., ingested or inhaled) in a high enough percentage. The coating of the present invention can substantially mitigate the release of such gas or liquid to allow the particles of viscoelastic, elastomeric, and/or polymeric material to be substantially non-toxic and odorless. This allows particulate insulation materials that include VOCs to be used in home applications. In addition to mitigating the release of VOCs and odors, the coating **12** in accordance with the present invention can improve heat stability or flame retardance of the particulate viscoelastic, elastomeric, and/or polymeric material as well as provide anti-blocking or anti-agglomeration effects to the particles.

[0026] Coupling agents that can be used as a surface coating **12** in accordance with invention include silanes, such as organic silanes (e.g., $R_nSi(OR)_{4-n}$ with "R" being an alkyl, aryl, or organofunctional group and with "OR" being methoxy, ethoxy, or acetoxy) as well as amino silanes, and hydroxy silanes (e.g., SILQUEST, such as A-174, A-189 and A-1100, which are commercially available from GE Advanced Materials). Polymeric materials that can be used as the coating agent include a urethane, an epoxy, an acrylic, a silicone, a latex, a siloxane, and blends thereof.

[0027] It will be appreciated by one skilled in the art that other polymeric materials, as well as other coupling agents, can be used to form the surface coating **12** as long these other materials can mitigate release of odors and/or VOCs from the particles of insulation of material. It will also be appreciated that the particles of viscoelastic, elastomeric, and/or polymeric material need not be provided with a surface coating **12** if such particles are substantially odorless and free of VOCs.

[0028] The particles of viscoelastic, elastomer, and/or polymeric material can be provided with the surface coating **12** using conventional coating methods. Such conventional coating methods can include spray coating, dip, or immersion coating, as well as barrel coating methods. It will be appreciated that the particular coating method will be dependent on the particular polymer and/or coupling agent used to form the surface coating **12**.

[0029] The particulate insulation material in accordance with the present invention can further include one more agents that can act as a flame retardant, fungicide, insecticide, mildewcide, bactericide, colorant, radiation absorber (e.g., actinic or UV), or anti-blocking agent. For example, a number of various insecticides or mildewcides can be used including organic based compounds, such as borax, boric acid, or other organo-chemical compounds. Organic based insecticides that can be used include, for example, those sold under the names Diazinon and Malathion. Examples of flame retardants that can be used include alumina hydrate, bromides, and/or borax hydrate, which on combustion release water or other compounds to extinguish flames. The colorant can be added to facilitate identification of particular insulation blends. These agents can be compounded with the particles of viscoelastic, elastomeric, and/or polymeric material and/or mixed with the surface coating material.

[0030] Optionally, the particulate insulation material can include at least one filler. The filler can comprise any relatively inert substance that can be used to modify (e.g., increase or decrease) the density of the particulate insulation material so that the particulate insulation material has a density greater than about 1.0 g/cm^3. The filler will generally be in the form of small particles (e.g., less than about 0.5 mm), although it will be appreciated that larger particles (e.g., greater that about 0.5 mm) can also be used. The filler in addition to modifying the density of the particulate insulation material can also be used to provide or modify other properties of the particulate insulation material. For example, the filler can be used to modify the thermal and/or acoustic insulation properties. Moreover, the filler can act as a flame retardant, insecticide, pigment, free-flow additive, and/or surface texture modifier.

[0031] Examples of fillers that can be used in accordance with the present invention can include talc, glass beads, dolomite, calcium carbonate, glass microspheres, fly ash, clay, silica, silicate, perlite, vermiculite, aluminum hydrate, and barium sulfate, aluminum silicates, carbon black, kaolin, diatomite, keratin, mica, and molybdenum disulfide. It will be appreciated that the fillers used in accordance with the present invention need not be limited to the foregoing fillers and that other fillers can also be used. The filler, like the additives, can be compounded with the particles of viscoelastic, elastomeric, and/or polymeric material, or mixed with the surface coating.

[**0032**] It will also be appreciated that small amounts of a free-flow additive and/or a carrier fluid can be added to the surface of the particulate insulation material to facilitate transport and free-flow of the particulate insulation material. The free-flow additive can include a powdered material, such as talc, that can be applied to the surface coating material. The carrier fluid can include an oil, such as silicone oil or mineral oil, or other inert fluid that can be readily mixed with the particulate insulation material.

[**0033**] In an aspect of the invention, the particulate insulation material can be used alone as a free flowing dry particulate material. When used as a free-flowing dry particulate material, the particulate insulation material preferably has an average particle size of about 2.0 mm to about 20 mm. This average particle size allows the free-flow particulate insulation material to be readily provided in cavities of construction assemblies, such as crawl spaces, walls, and between ceiling joists or floor joists, by conventional pumping or blowing methods. It will also be appreciated that the free-flowing particulate insulation material can be provided with a polydiverse particle size distribution and different shapes to tailor the packing density and void density of the insulation material. Tailoring the packing density and the void density allows both the thermal and acoustic insulation properties of the particulate insulation to be readily adjusted for specific applications.

[**0034**] Apparatuses for pumping or blowing particulate insulation material in cavities of construction or structural assemblies are well known. These apparatuses can typically include a feed pipe that is connected to a blower or pump. The blower or pump can provide an air stream or create pressure, which will move the particulate insulation material through the feed pipe to the cavity.

[**0035**] Optionally, the particulate insulation material can be brought to the point of installation of a construction assembly, such as a wall or ceiling cavity, in the form of a continuous roving or strand that can be wrapped or wound about a spool. At the point of installation, the continuous roving or strand can be unwound and continuously passed through a cutting device or "chopper gun". The cutting device cuts or chops the roving or strand into a free-flowing dry particulate material (e.g., average particle size or cut length of about 2.0 mm to about 20 mm) that can be provided in the wall or ceiling cavity. It will be appreciated by one skilled in the art that other methods or means of providing the free-flowing particulate material in cavities of construction or structural assemblies can also be used.

[**0036**] **FIG. 2** is a schematic illustration that shows the free flowing particulate insulation material **20** provided between walls **22** of a construction assembly **24**. The free-flowing particulate insulation material **20** can be arranged between the walls **22** such that individual particles **26** contact each other and form an insulation with a plurality of dead air-cells **30** substantially uniformly distributed between the particles **26**. These dead air-cells **30**, along with the specific density and viscoelastic properties of the polymer, provide both thermal and acoustic isolation and damping effects. The free-flowing particulate insulation material **20** provided between the walls **22**, unlike fibrous or expanded insulation, is resistant to compaction and, therefore, can maintain the dead-air cells **30** between the particles **26** over time. The amount of dead-air cells **30** between the particles **26** of particulate insulation material **20** will be dependent on the particle size distribution and the shapes of the individual particles **26** of insulation material **20**.

[**0037**] In another aspect of the invention, the particulate insulation material can be mixed with a vehicle system or resin system to provide a coating composition that can be coated on to the surface of an assembly, such as a ceiling or wall, the interior surface of a vehicle or appliance, or the exterior surface of a pipe or duct. The particulate insulation material, when used in a coating composition, preferably has an average particle size of about 0.04 mm to about 4.0 mm and comprises about 20% to about 50% by weight of the coating composition. It will be appreciated that the average particle size and weight percentage of the particulate insulation material in the coating composition can be greater or lower depending on the formulation and the specific use.

[**0038**] The resin system used in the coating composition can include polymers, such as resins, latexes, urethanes, epoxies, and acrylics, as well as water reducible resins and other well-known polymers that are used in coating compositions. The polymers should preferably be in the form of a liquid in an uncured state and readily solidify once cured. Curing of the polymers can be performed by, for example, drying or chemical reaction.

[**0039**] The coating composition should have a viscosity that allows the coating composition to be readily applied to surfaces by established techniques of spray coating, dip coating, extrusion coating, flow coating, spread coating, brush coating, pouring, or gravity flow methods. Depending on the particular formulation, the viscosity of the coating composition can be modified (e.g., lowered) by including one or more diluents (e.g., water or glycol) and/or other liquids. The diluent and/or other liquid should readily dilute the resin system but not dilute or solvate the particulate insulation material.

[**0040**] Optionally, the coating composition can include other compounds, such as fillers and other ingredients described above, which can be added to the particulate insulation material. One particular ingredient that can be advantageously provided in the coating composition is a pigment or colorant. The pigment or colorant can be used to readily distinguish different formulations or different coating compositions, which are applied to particular surfaces.

[**0041**] In a further aspect of the invention the particulate insulation material can be mixed with a viscous resin or polymer to provide a mastic or paste that can be provided in a cavity or on the surface of an assembly. The particulate insulation material, when used in a mastic or paste composition, preferably has an average particle size of about 1.0 mm to about 10.0 mm and comprises about 20% about 95% by weight of mastic or paste composition. It will be appreciated that the average particle size and weight percentage of the particulate insulation material in the mastic or paste composition can be greater or lower depending on the formulation and the specific use.

[**0042**] The viscous resin or polymer used to form the mastic or paste can include any resin polymer than can act as a bounding agent to hold the particles together and/or bind the mastic or paste to the surface or substrate. Examples of polymers or resins that can be used include polyesters, polyamides, polyurethanes, epoxies, latexes, water reducible resins, polybutadiene SBR polymers, and acrylics/acrylates, as well as other well-known polymers that are used in mastic or paste compositions. The polymers should preferably be a viscous liquid in an uncured state and readily solidified once cured. Curing of the resin or polymers can be performed, by for example drying or chemical reaction.

[0043] The mastic or paste should have a viscosity such that the mastic or paste can be applied to surfaces or cavities by, for example, troweling, brushing, pouring, or gravity flow techniques. Depending on the particular formulation, the viscosity of the coating composition be modified (e.g., lowered or increased) by including a viscosity modifier or by adjusting the formulation of the resin system.

[0044] Optionally, the mastic or paste composition, like the coating composition, can include other compounds, such as fillers and agents described above, which can be added to the particulate insulation material. It will be appreciated that other fillers or agents besides the fillers and agents described above can be used in accordance with the present invention.

[0045] From the above description of the invention, those skilled in the art will appreciate improvements, changes, and modifications. Such improvements, changes and modifications are intended to be covered by the appended claims.

Having described the invention, I claim the following:

1. An insulation comprising:

a plurality of free-flowing particles, each of the particles having a density of at least about 1 g/cm^3 and including a material, the material being at least one of a viscoelastic, elastomeric, or polymeric material, the particles being substantially non-toxic, non-hygroscopic, odorless, and resistant to volatile organic compound (VOC) emissions.

2. The insulation of claim 1, the material being selected from the group consisting of a crumb rubber, a reground polymer, a recycled polymer, a virgin polymer, and blends thereof.

3. The insulation of claim 1, the particles comprising crumb rubber having an average particle diameter of about 0.04 mm to about 25 mm.

4. The insulation of claim 1, each particle including a coating that encapsulates the material of each particle, the coating being substantially impermeable and mitigating emission of odor and VOCs from the material.

5. The insulation of claim 4, the coating being substantially free of voids and comprising less than about 20% by volume of the particles.

6. The insulation of claim 5, the coating being selected from the group consisting of a coupling agent, a urethane, an epoxy, an acrylic, a silicone, a latex, a water reducible resin, and blends thereof.

7. The insulation of claim 1, the particles further including at least one of a fungicide, insecticide, mildewcide, bactericide, colorant, flame retardant, radiation absorber, or anti-blocking agent.

8. The insulation of claim 1, the particles further including a filler in an amount effective to provide each particle with a density greater than about 1 gram/cm^3.

9. The insulation of claim 8, the filler being selected from the group consisting of talc, glass beads, dolomite, calcium carbonate, glass microspheres, fly ash, clay, silica, silicate, perlite, vermiculite, aluminum hydrate, and barium sulfate.

10. The insulation of claim 1 having an R-value of at least about 2.0 per inch and an STC factor of at least about 20.

11. The insulation of claim 1, being provided in a coating composition or fluid carrier system.

12. The insulation of claim 1, being provided in a mastic.

13. The insulation of claim 1, being capable of damping, attenuating, or isolating at least one of vibrational energy, acoustic energy, thermal energy, electromagnetic energy, or radio waves.

14. An assembly including an insulation: the insulation comprising a plurality of free-flowing particles, each of the particles having a density of at least about 1 g/cm^3 and including a material, the material being at least one of a viscoelastic, elastomeric, or polymeric material, the particles being substantially non-toxic, non-hygroscopic, odorless, and resistant to volatile organic compound (VOC) emissions.

15. The assembly of claim 14, the material being selected from the group consisting of a crumb rubber, a reground polymer, a recycled polymer, a virgin polymer, and blends thereof.

16. The assembly of claim 14, each particle including a coating that encapsulates the material of each particle, the coating being substantially impermeable and mitigating emission of odor and VOCs from the at least one of viscoelastic, elastomeric, or polymeric material.

17. The assembly of claim 16, the coating being substantially free of voids and being selected from the group consisting of a coupling agent, a urethane, an epoxy, an acrylic, a silicone, a latex, water reducible resins, and blends thereof.

18. The assembly of claim 14, the insulation further including at least one of a fungicide, insecticide, mildewcide, bactericide, colorant, flame retardant, radiation absorber, or anti-blocking agent.

19. The assembly of claim 14, the insulation having an R-value of at least about 2.0 per inch and a STC factor of at least about 20.

20. The assembly of claim 14, being capable of damping, attenuating, or isolating at least one of vibrational energy, acoustic energy, thermal energy, electromagnetic energy, or radio waves.

21. The assembly of claim 14, the insulation material being provided in a coating composition or fluid carrier system, the coating composition or fluid carrier system being capable of adhering to a surface of the structural assembly.

22. A coating composition comprising:

a plurality of free-flowing particles, each of the particles having a density of at least about 1 g/cm^3, an average particle size of about 0.04 mm to about 4.0 mm and including a material selected from the group consisting of a crumb rubber, a reground polymer, a recycled polymer, a virgin polymer, and blends thereof, the coating composition being capable of damping, attenuating, or isolating at least one of vibrational energy, acoustic energy, thermal energy, electromagnetic energy, or radio waves.

23. The coating composition of claim 22, further including at least one of a fungicide, insecticide, mildewcide, bactericide, colorant, flame retardant, radiation absorber, or anti-blocking agent.

24. The coating composition of claim 23, the particles further including a filler selected from the group consisting of talc, glass beads, dolomite, calcium carbonate, glass microspheres, fly ash, clay, silica, silicate, perlite, vermiculite, aluminum hydrate, barium sulfate, and combinations thereof.

25. The coating composition of claim 23, having a viscosity sufficient to allow the coating composition to be sprayed on a surface of an assembly.

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